

### TARDIGRADES ATTACKING NEMATODES.

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Tardigrades (water bears) are invertebrates with elongate oval bodies (Fig. 1) usually comprised of 4 body segments and a head. Eye spots are usually present. Four pairs of legs are present with complex claws attached. The mouth is equipped with 2 stylets used as piercing and feeding structures. Identification is based largely on claw structure (1). The usually bisexual female lays eggs in a sac (Fig. 2).

Tardigrades were first reported from sand in a roof spout in Italy by Corti, 1774 (3). They are commonly found in moss, tree bark, freshwater, and soil. They ingest only liquids, using 2 stylets to pierce the cell or body wall of algae, rotifers, protozoa and nematodes (4). Tardigrades survive extreme environmental pressures; e.g., drying, freezing, or high salinity, by transforming their bodies into resistant cysts or assuming a shriveled, rounded anabiotic state (6). A museum specimen of dry moss 120 years old yielded live tardigrades upon moistening. Soil population densities have been estimated at 300,000/m<sup>2</sup> L(3).

During 25 years of observing live mixed invertebrate populations, tardigrades had been noted by the author in numerous nematode soil collections from a wide range of plant hosts. Tardigrades were active in many cultures containing live nematodes, mites, protozoa, and oligochaetes, but several years passed before tardigrades were observed feeding. A rapacious population of tardigrades in the genus Hypsibius was noted actively attacking and feeding for several hours at random on a live nematode population from soil about the roots of St. Augustine grass.

Tardigrades were seen passing quite close to nematodes (10 microns) without an assault. Once tardigrade lips contact the nematode cuticle, a suction appears to form and the nematode is pierced by the tardigrade stylet. One nematode held at midbody by the tardigrade lips was levered up and down. Two unsuccessful attacks were noted. One nematode (Enchodelus), 3 1/2 times longer than the tardigrade, was seized at midbody and small water insoluble droplets formed about the tardigrade lips, one of which remained on the nematode body after the nematode escaped several minutes after seizure. An unsuccessful attempted penetration of a large dorylaim was also noted. Numerous nematodes, mostly bacteriophagous types were vigorously attacked at various parts of the body, or in a few cases, prolapsed partially into the tardigrade oral aperture (Fig. 3). In one case, the tardigrade punctured the nematode in the side and fed on the material issuing from the rupture. One nematode was pierced in the head region and the body contents sucked out. Two nematodes were seized by the tail, one being held for 3 and one-half hours in this manner (Fig. 4). For many years following this observation many tardigrades were seen in similar situations but never attacking or feeding on nematodes.

Several large populations of tardigrades were placed on water agar containing numerous nematodes of many genera and observed for several weeks. No feeding or attacking by the tardigrades was noted. The population of tardigrades in agar dishes

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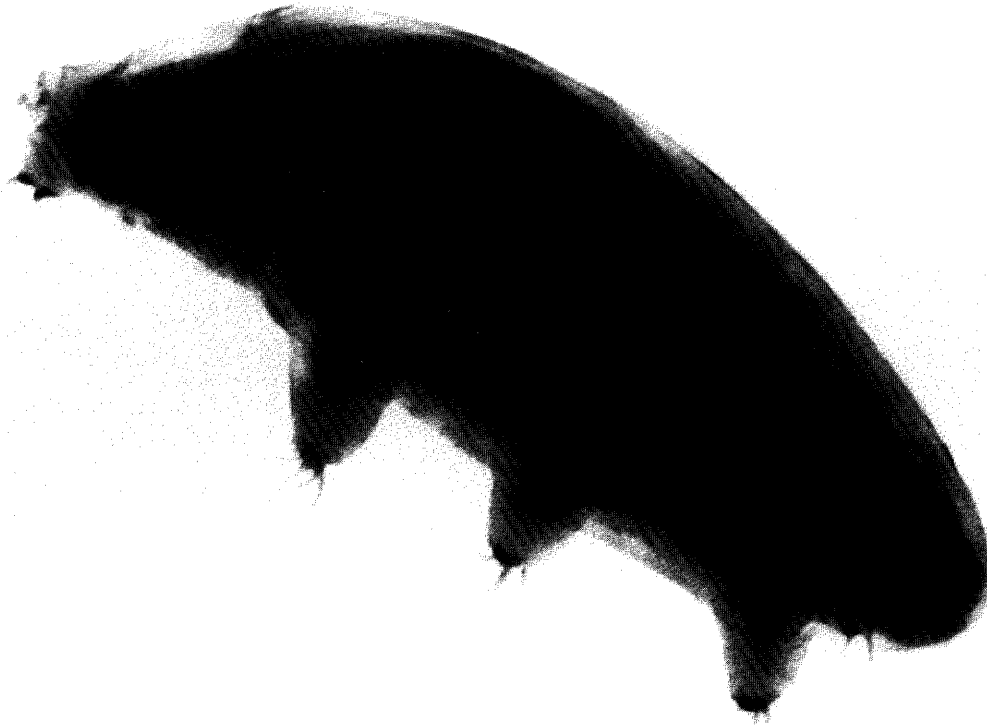


Fig. 1. A soil tardigrade.

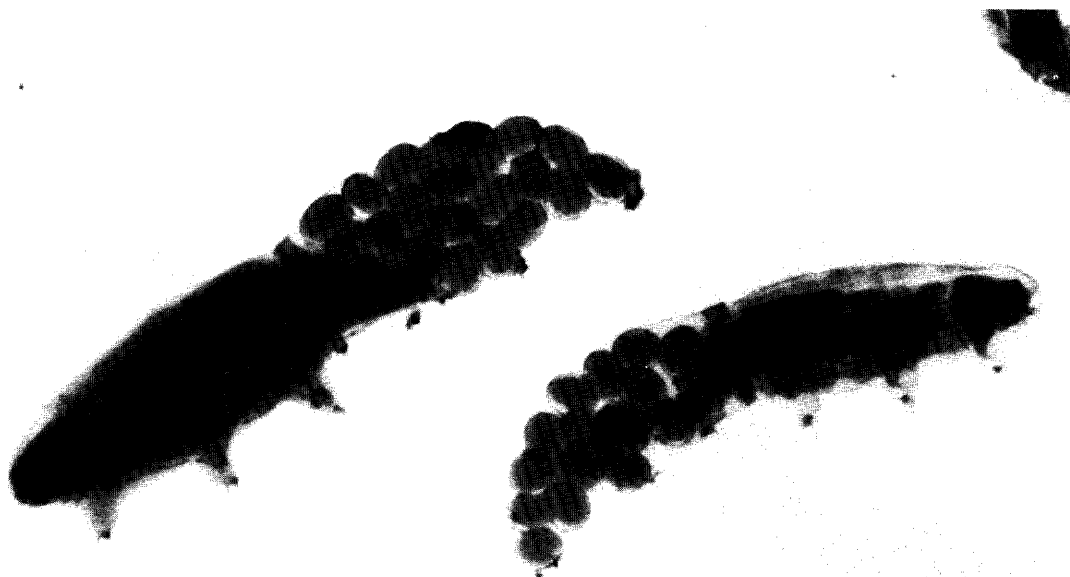


Fig. 2. Female tardigrades with eggs attached.

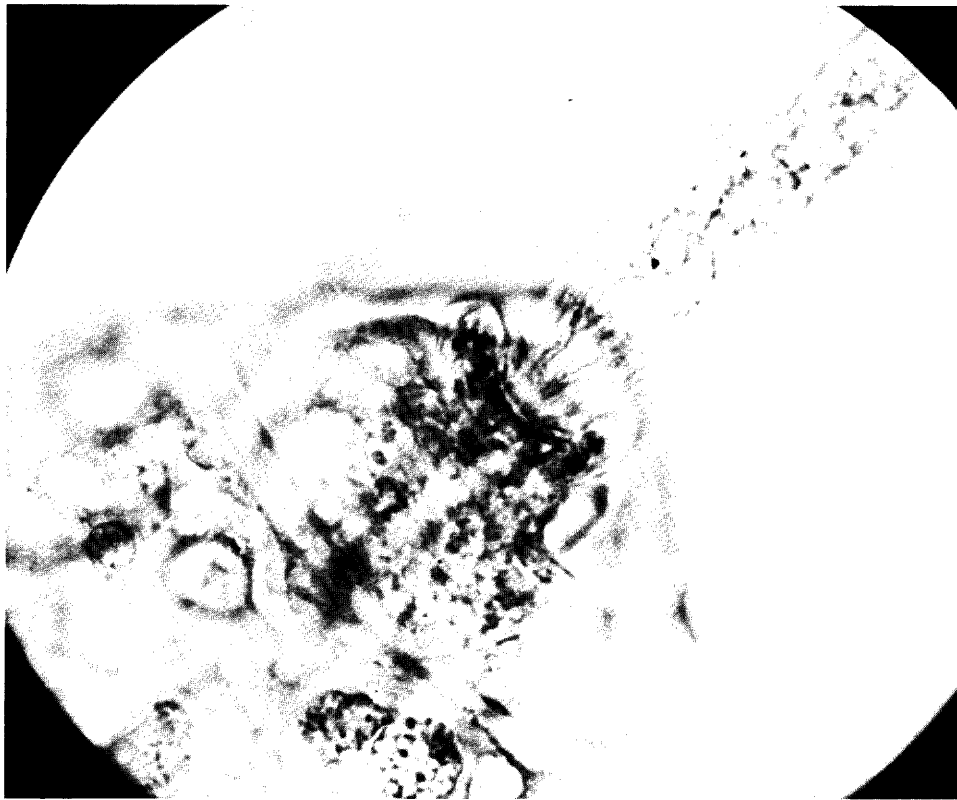


Fig. 3. A close up of a male nematode held by the tail  
in the oral aperture of a tardigrade.

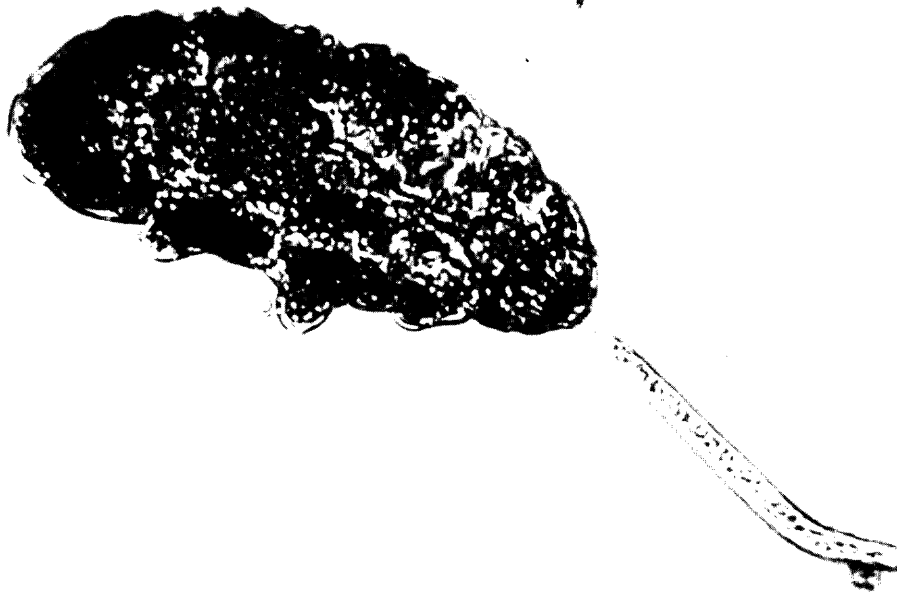


Fig. 4. A larval Trichodorus held by a tardigrade.

became immobilized after several days and deterioration set in. In the same mixed colonies, predaceous nematodes actively attacked and fed on other nematodes for several weeks.

**Discussion:** Linford (5) noted that tardigrades of the genus Macrobiotus were predaceous enemies of root-knot nematodes. Hutchinson and Streu (4) and Doncaster and Hooper (2) noted tardigrades attacking nematodes and that a firm attachment was made of the oral aperture to the nematode body. In these observations prey location appeared random. Hutchinson and Streu's observation of a firm attachment of tardigrade to nematode is construed as a suction. Extra-oral digestion is indicated by an oral secretion noted at the point of attack. The rarity of attacks in agar cultures by tardigrades suggests that conditions under which they feed are rarely attained out of their normal habitat. The savagery of an almost entire population of tardigrades against nematodes indicated a possible strong predator role for tardigrades against nematodes under special environmental conditions.

LITERATURE CITED:

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